

TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

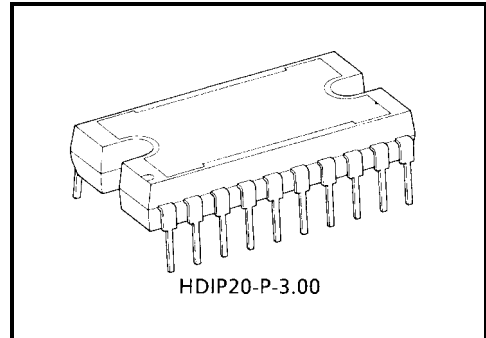
TA7247AP

DC Motor Driver

The TA7247AP is a 3-phase Bi-directional supply-voltage-controlled motor driver IC providing all the active functions necessary for switching-regulator-controlled FAN MOTOR of electrical Air conditioner.

It's designed for especially energy saving air conditioner applications and suitable for use any other motor driver applications.

It contains 3-phase Bi-directional power driver, CW/CCW control circuit, comparator and oscillator for switching regulator, and protect circuits.

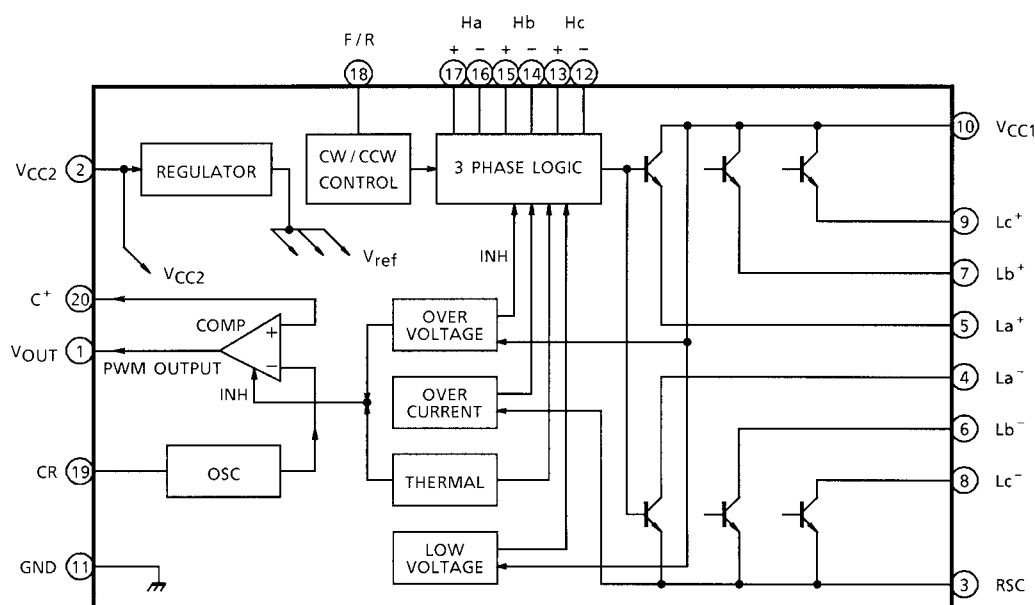


Weight: 8.19 g (typ.)

Features

- Voltage controlled 3-phase bi-directional motor power driver
- Output current up to 1.5 A
- High sensitivity of position sensing inputs: $V_H = 40 \text{ mV (typ.)}$
- Built in over current, over voltage, low voltage and thermal protect circuit
- More power-up applications with additional power transistors
- Recommended supply voltage:
 $V_{CC1} \text{ (opr.)} = 0 \text{ to } 30 \text{ V}$
 $V_{CC2} \text{ (opr.)} = 4.5 \text{ to } 5.5 \text{ V}$

Block Diagram

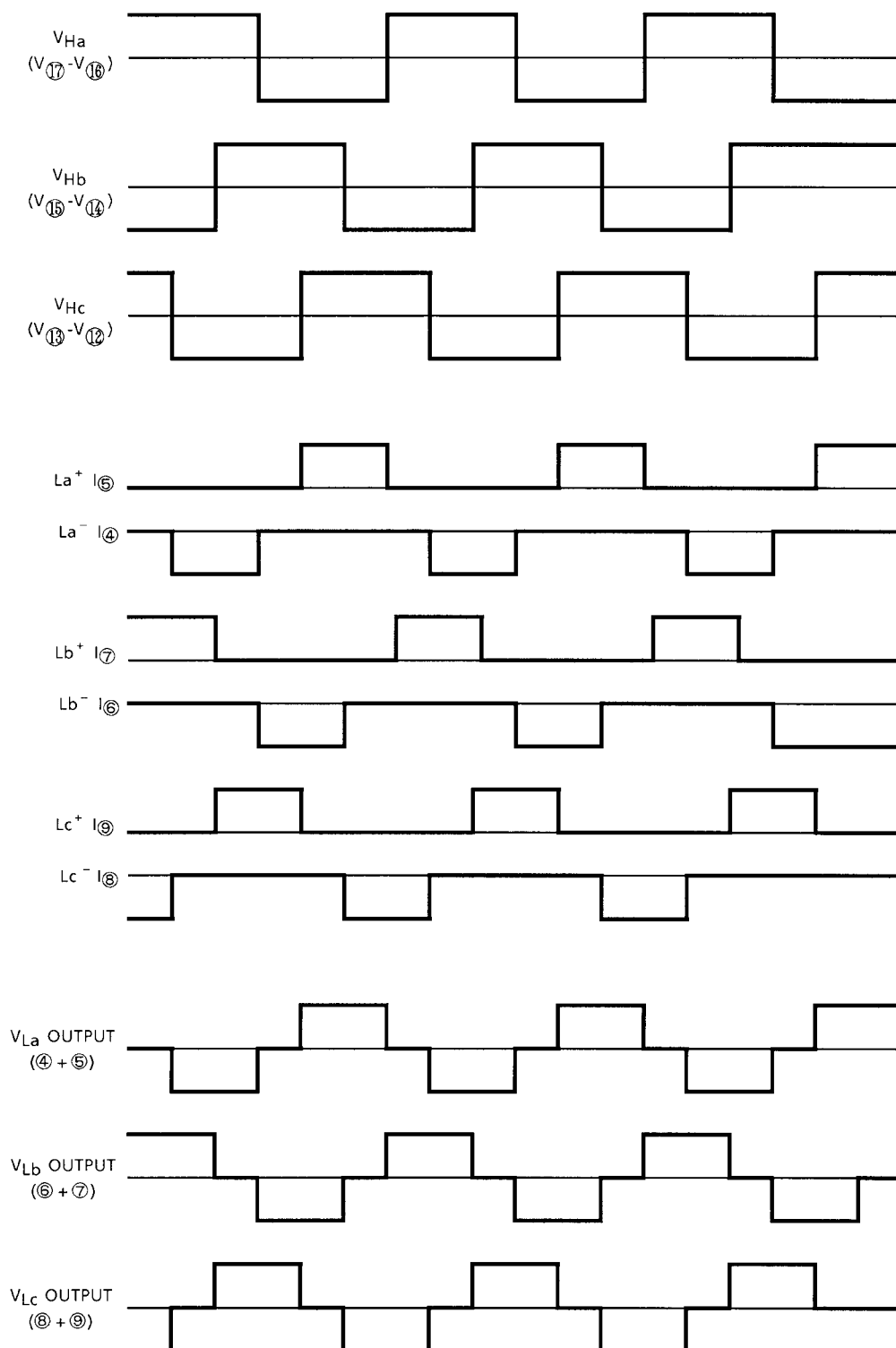


Pin Function

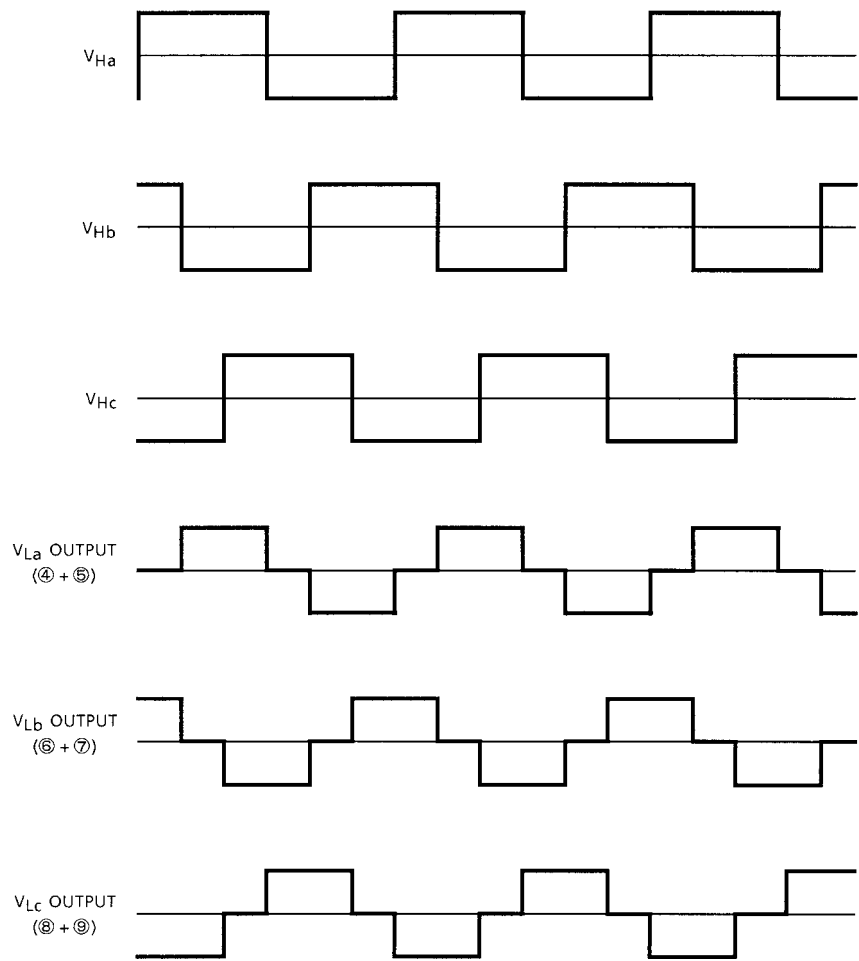
Pin No.	Symbol	Functional Description
1	V _{OUT}	PWM output terminal
2	V _{CC2}	Power supply input terminal
3	RSC	Output current detection terminal
4	La ⁻	a-phase lower drive output terminal
5	La ⁺	a-phase upper drive output terminal
6	Lb ⁻	b-phase lower drive output terminal
7	Lb ⁺	b-phase upper drive output terminal
8	Lc ⁻	c-phase lower drive output terminal
9	Lc ⁺	c-phase upper drive output terminal
10	V _{CC1}	Drive power supply input terminal
11	GND	GND terminal
12	Hc ⁻	c-phase Hall amp negative input terminal
13	Hc ⁺	c-phase Hall amp positive input terminal
14	Hb ⁻	b-phase Hall amp negative input terminal
15	Hb ⁺	b-phase Hall amp positive input terminal
16	Ha ⁻	a-phase Hall amp negative input terminal
17	Ha ⁺	a-phase Hall amp positive input terminal
18	F/R	Logic mode select pin for CW/CCW
19	CR	Capacitor connection terminal for reference oscillation
20	C ⁺	Comparator reference voltage input terminal

Function

a) Forward rotation mode (Pin (18) open or 2.5 V min)



b) Reverse rotation mode (Pin (18) GND or 0.4 V max)



Mode	F/R	Outputs
CW	H	$L_a = H_c - H_a$ $L_b = H_a - H_b$ $L_c = H_b - H_c$
CCW	L	$L_a = H_a - H_b$ $L_b = H_b - H_c$ $L_c = H_c - H_a$

Note: CW and CW have the different logical formulas, which are shown above table. Please note that F/R pin can not control selection of CW and CCW in the same motor.

Application of TA7247AP

(1) Design method of switching regulator oscillation circuit (PWM generating circuit)

The PWM wave generating circuit that controls the switching regulator output switching transistors is shown in Figure 2.

The circuit consists of a triangular waveform generating circuit that generates a comparison signal and a comparator that compares the comparison signal from the triangular waveform generating circuit with output voltage from the switching regulator. (In the example shown in Figure 2, output level is such that "H" level is at VCC2 level (≈ 5 V) and "L" level is typically at 0.5 V as specified in the standard.)

In this oscillation circuit, positive feedback is added to the differential comparator to provide hysteresis. "H" and "L" levels of triangular waveform output are expressed, respectively, by the following equations:

$$V_{CR \text{ MAX.}} = \frac{R_2 + R_3}{R_1 + R_2 + R_3} \cdot V_{CC2} \approx 2.69 \text{ V}$$

$$V_{CR \text{ MIN.}} = \frac{R_2}{R_1 + R_2} \cdot V_{CC2} \approx 1.25 \text{ V}$$

Q1 shown in Figure 2 is for a discharge path and R4 decides discharging time constant together with an external capacitor Cf.

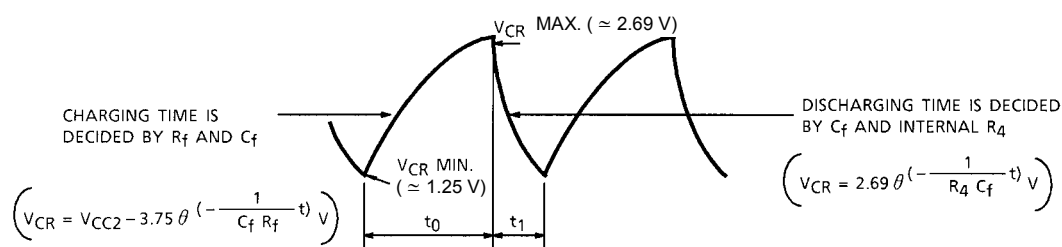


Figure 1 Triangular waveform generating circuit output waveform (Pin (19))

Further, oscillation periods t_0 and t_1 are decided by the following equations:

$$t_0 \approx 0.4845 \cdot C_f \cdot R_f \text{ (s)}$$

$$t_1 \approx 0.7664 \cdot C_f \cdot R_4 \text{ (s)}$$

Where, R4 is an internal resistor ($\approx 1.3 \text{ k}\Omega$)

Further, as resistance of the resistor R4 in IC varies by about $\pm 20\%$, it is recommended to use R4 in actual application at $R_f > R_4$ to suppress internal fluctuation of resistance in IC at the minimum level.

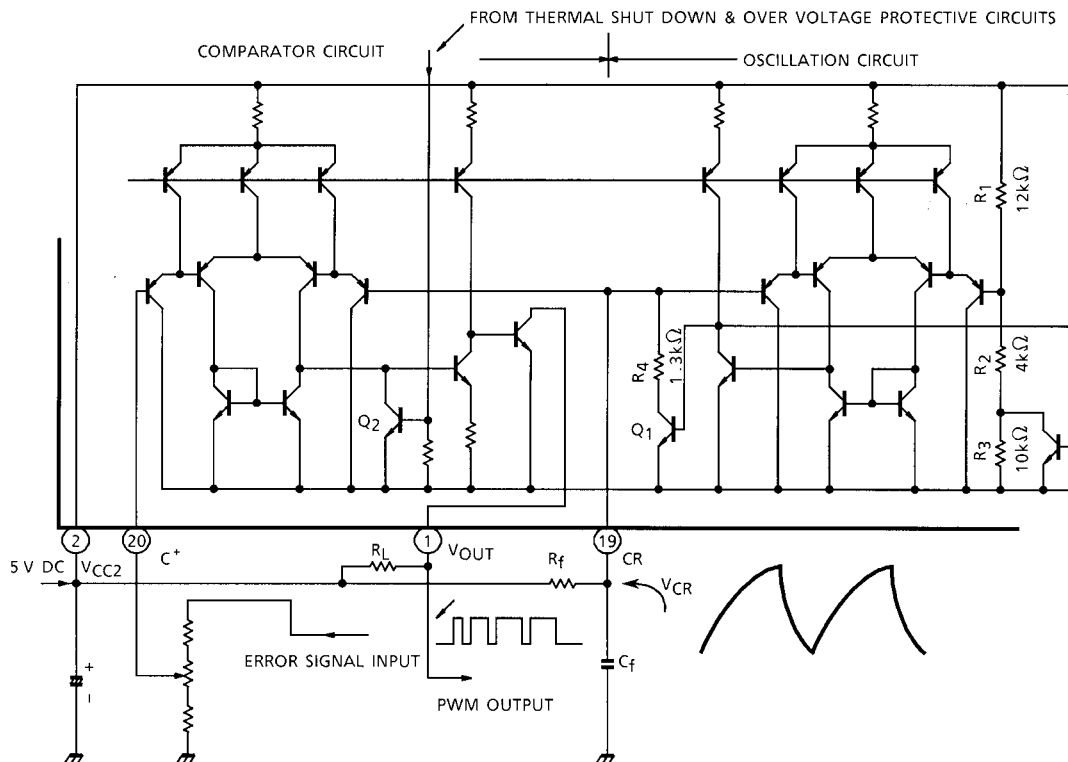


Figure 2 PWM waveform generating circuit

The comparator circuit consists of a differential amplifier which is operated by PNP differential input. DC level to the C⁺ terminal is decided by DC level at the CR terminal (pin (19)) and required duty ratio.

As DC level at the CR terminal is 1.25 to 2.67 V as shown in Figure 1, it is recommended to input DC at a level corresponding to DC level at the CR terminal.

Further, R_f and Triangular waveform oscillation period characteristic is shown in Figure 3 and PWM output waveform duty ratio vs. pin (20) voltage characteristic in Figure 4.

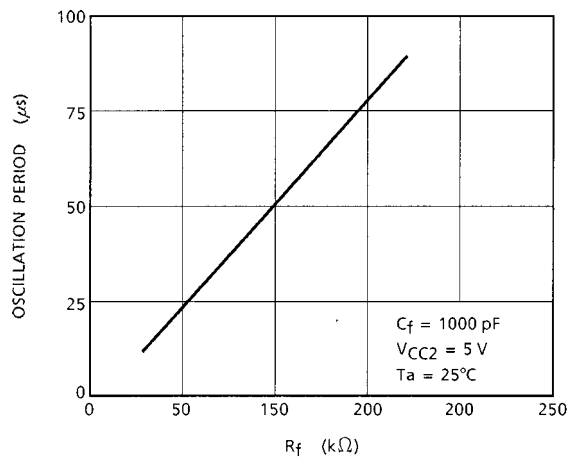


Figure 3 R_f -Oscillation period characteristic

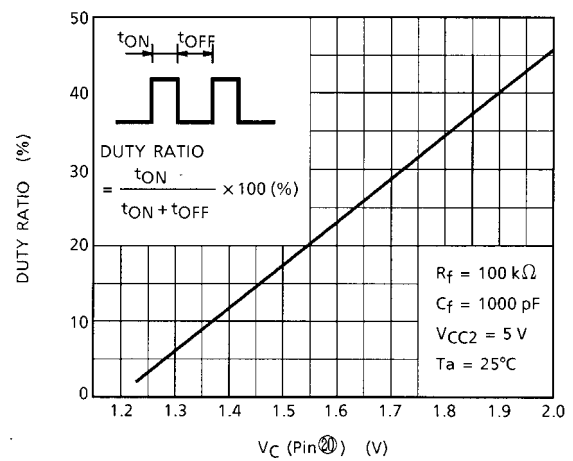


Figure 4 DUTY RATIO- V_C characteristics

(2) Position detecting circuit (Hall element input circuit)

The Position detecting circuit is shown in Figure 5.

This circuit consists of a differential amplifier having hysteresis (≈ 20 mV, typ.).

As operating DC level (CMR) is about 1.5 V at the lower side and $V_{CC} - 1.8$ V at the upper side, it is recommended to input constant voltage drive from V_{CC2} at level higher than hysteresis by 3 times or more (60 to 70 mV_{p-p}).

If the hall element is removed during the rotation, IC can be destructed.

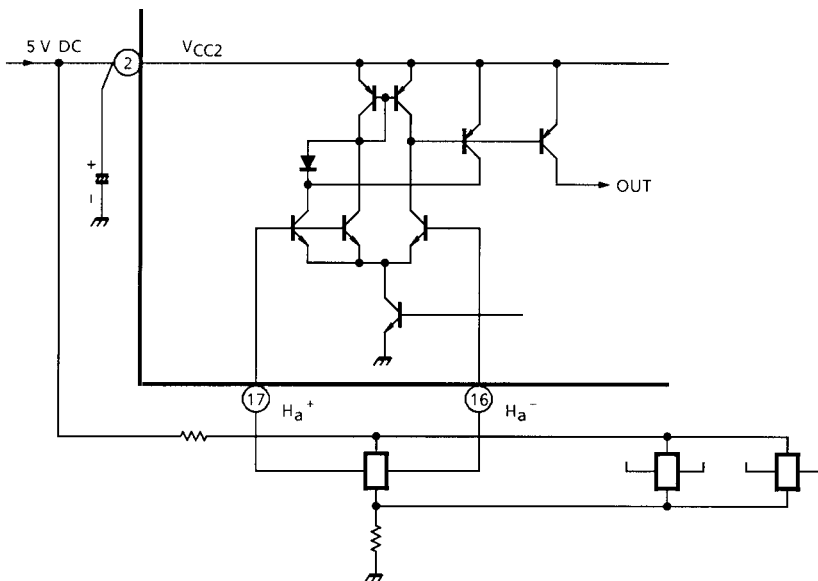


Figure 5 Position detecting circuit (hall element input)

(3) Output circuit

in Figure 7. The upper side of the circuit (pins (5), (7) and (9)) is for outlet, whichle the lower side (pins (4), (6) and (8)) is for intake. When the built-in output transistors are used, pins (4) and (5), (6) and (7), and (8) and (9) shall be shorted, respectively.

When transistors are externally mounted for increasing the capacity largely, they shall be connected as shown in Figure 7.

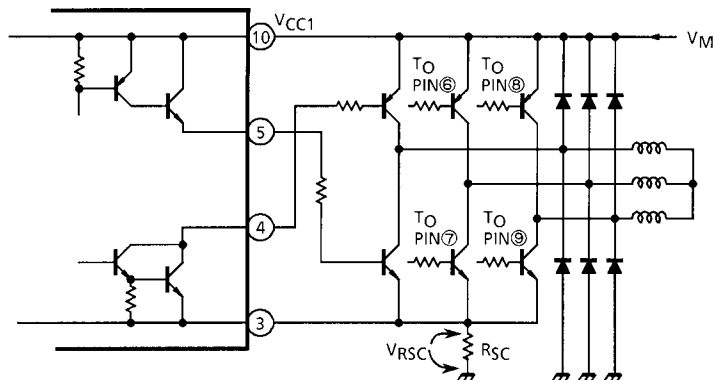


Figure 6 Output circuit

(4) Protective circuits

a) Over voltage protective circuit

If voltage at VCC1 terminal exceeds normal voltage (38 V), Q2 in Figure 2 is ON to inhibit PWM output and at the same time, the output circuit is OFF.

b) Thermal shut down circuit

If temperature at the junction point exceeds specified temperature (150°C), similar to a), above, Q2 in Figure 2 in ON to inhibit PWM output and at the same time, the output circuit is OFF.

c) Over current protective circuit

If VRSC in Figure 7 exceeds specified voltage ($VRSC = RSC \cdot ISC$), the output circuit is OFF.

d) Excessively low voltage protective circuit

If voltage at VCC1, terminal drops below specified voltage, the output circuit is OFF.

Further, this circuit is a malfunction preventive circuit.

Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Supply voltage (motor)	V _{CC1}	38	V
Supply voltage (control)	V _{CC2}	7	V
Output current	I _O	1.5	A
Power dissipation	P _D (Note)	25	W
Operating temperature	T _{opr}	-30 to 75	°C
Storage temperature	T _{stg}	-55 to 150	°C

Note: T_C = 75°C

Electrical Characteristics (unless otherwise specified, V_{CC2} = 5 V, Ta = 25°C)

Characteristics		Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Quiescent current		I _{CC}	—	I _O = 0.75 A	—	15	20	mA
Saturation voltage	Upper side	V _{SAT1}	—	I _O = 0.75 A	—	1.5	2.1	V
				I _O = 0.9 A	—	1.7	2.4	
				I _O = 1.2 A	—	1.9	—	
	Lower side	V _{SAT2}	—	I _O = 0.75 A	—	1.4	2.0	
				I _O = 0.9 A	—	1.5	2.3	
				I _O = 1.2 A	—	1.7	—	
Leak current	Upper side	I _{LU}	—		—	—	100	μA
	Lower side	I _{LL}	—		—	—	100	μA
Current limiter sensitivity		V _{RSC}	—	RSC = 0.2Ω	180	220	300	mV
Over voltage protector operating voltage		V _{H·SE}	—		38	—	—	V
Thermal shut-down operating temperature		T _{TSD}	—		150	—	—	°C
Low voltage protector operating voltage		V _{L·SE}	—		—	5.7	—	V
Position sensing input sensitivity		V _{th}	—	Sine wave (100 mV _{p-p} , 30 Hz)	—	20	—	mV
Oscillator	Frequency	f _O	—	R _f = 68 kΩ, C _f = 1000 pF	—	30	—	kHz
	Amplitude	A _O	—		—	1.2	—	V _{p-p}
	Temperature-coefficient	T _{CV} f _O	—		—	0	—	Hz/°C
Comparator	Output current	I _{COM}	—		—	—	—	mA
	Saturation voltage	V _{SAT COM}	—	V ₍₂₀₎ = 0 V	—	0.5	—	V
	Turn-ON time	t _r	—		—	0.5	—	μs
	Turn-OFF time	t _f	—		—	0.5	—	μs
	Duty ratio	D _y	—	V ₍₂₀₎ = 2 V	—	50	—	%
	Duty ratio temperature coefficient	V _{CV} D _y	—		—	0	—	%/°C

[illegible]

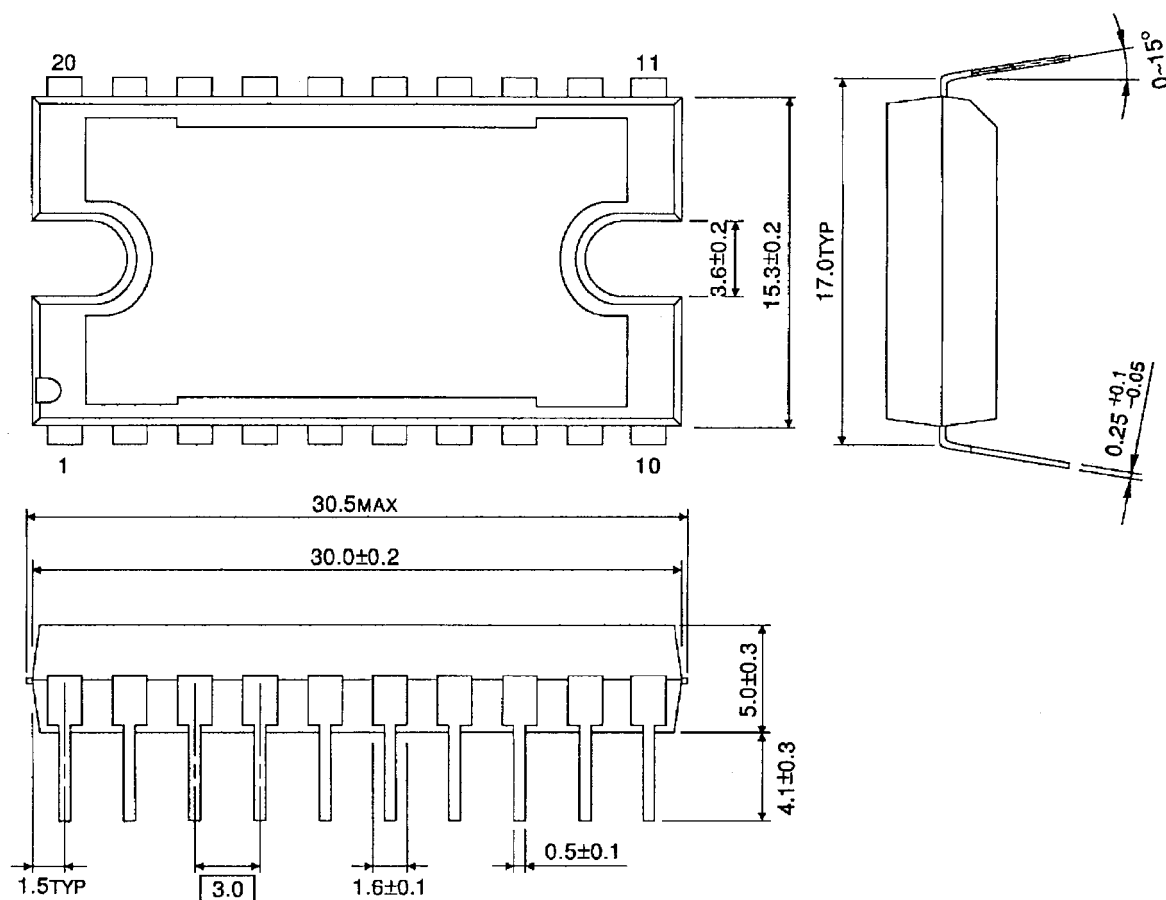
In this case, the connection shall be made as shown in the above circuit diagram.

2003-10-07

Package Dimensions

HDIP20-P-3.00

Unit : mm



Weight: 8.19 g (typ.)

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